

XVI. *Actual Fire and Detonation produced by the Contact of Tin-foil, with the Salt composed of Copper and the Nitrous Acid. By B. Higgins, M. D. Communicated by R. Brocklesby, M. D. F. R. S. and of the Royal College of Physicians in London.*

Read Dec. 24, 1772, and Jan. 28, 1773. **S**EVERAL pieces of thin sheet-copper, placed vertically, and at a small distance from each other, in the strong nitrous acid diluted with half its quantity, or more, of water, and suffered to remain in a close vessel, until the acid is saturated, afford a crystalline blueish green salt, which is to be separated from the undissolved copper and the superfluent green liquor, and kept in a well-corked bottle; because, on exposure to the air, it deliquesces.

This salt, taken moist, but not very wet, and beaten to the fineness of basket sea-salt, in a mortar, is to be strewed to the thickness of a shilling, on a piece of tin-foil, twelve inches in length and three in breadth.

Then the foil is to be instantly rolled up, so as to include the salt, as it lay, between the coils. The ends are to be shut by pinching them together,

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ther, and the whole is to be pressed flat and close.

All this being done as quickly as possible, the first phænomenon is—A part of the salt deliquesces.

2d. This part, impregnated with tin, changed in colour, and of a thicker consistence, begins to froth forth from the ends of the coil.

3d. A strong frothing, accompanied with moderate warmth.

4th. The emission of copious nitrous fumes.

5th. Heat intolerable to the fingers.

6th. Explosion and fire, which burst and fuse the tin-foil in several places, if it be very thin.

After many conjectures and experiments, I discovered a property in the cupreous salt, from which, and the known affinities of the bodies concerned, these appearances, however new and singular, may be accounted for.

The cupreous salt properly dried and placed where it may receive a heat, not much greater than what the hand can bear, takes fire. The circumstances which favour this ignition, and contribute to produce it in the smallest degree of heat, concur in the following convenient method of trying the experiment.

A piece of soft bibulous paper is to be dipped in the nitrous solution of copper, and dried before the fire two or three times alternately. Then it is to be approached towards the heat, as near as can be borne, by the hand which holds it without pain: there, if it has been sufficiently dried, it will presently catch fire, and burn to a brown calx.

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The easy ignition of the salt in a slight heat being thus ascertained, there is no room to doubt that the foregoing phænomena are produced in the following manner.

The acid of the liquor, which moistened the salt, quits the copper to unite with the tin, leaving the water to be imbibed by the contiguous salt of copper, which then dissolves, and acts briskly on the tin-foil.

It is well known that the action of the nitrous acid on tin is always accompanied with considerable heat and effervescence, and that the solution of metallic salts in watry liquors is hastened by heat.

In our experiment, the warmth generated by the first action of the cupreous solution, promotes the deliquescence of the crystallized salt. The union of the acid with the tin is rapid, not only as being assisted by heat, but on account of the great surface exposed; whence the strong frothing, and the extraordinary heat, by which the redundant moisture is carried away, and the undecomposed part of the cupreous salt, together with that lately formed with the tin, perfectly dried.

The heat generated upon both surfaces of a large expanse of tin, is concentrated by closely coiling it into a small compass, and being retained by the various surrounding laminæ of metal, it is necessarily accumulated to a quantity, which, if we may judge from the touch, is more than sufficient to fire the dry cupreous salt.

The salt formed with tin, and the nitrous acid, burns and sparkles in a red heat. Catching fire, therefore, from the ignited cupreous salt, it burns

with it, and assists in the detonation, which is common to all nitrous compositions in similar circumstances.

If the salt be very wet, there will not be much fire or explosion, because the heat will be dissipated before the salt can be sufficiently dried in every part.

If the salt be not moist, it cannot commence the action which is necessary; and there will be no fire, because there can be no hasty solution of the tin to give the requisite heat.

If the tin and salt be not coiled up in due time, there will be very little heat and no fire; because the dissipation of the heat from a broad expanse, keeps pace with the generation of it; and as the moisture exhales quickly in this manner, there is none left to renew the action on the tin and consequent heat, when the proper time of coiling has elapsed.

A piece of tin-foil, larger than that I have described, cannot easily be managed; smaller pieces give less fire in the direct proportion of their surfaces, and the quantity of salt which they can, at the same instant, reduce to the required state of dryness.

The sudden dissipation of the moisture appears to me the most curious of these phenomena. To render it the more observable, I made the following experiments.

I placed a piece of tin-foil, twelve inches long by two broad, loosely coiled, and standing vertically on the flattest end, in half a table-spoonful of the saturated solution of copper in the diluted nitrous acid, and found that scarce five seconds elapsed

elapsed from the time, when a brisk effervescence, accompanied with weak nitrous fumes, arose, until the liquor became a consistent mass, and sparks of fire issued from the coils of tin; which having attracted part of the solution above the common level, brought it into the condition in which it is readily dried, heated, and fired.

A like quantity of the same solution, kept in a strong boiling heat, does not acquire such consistence in a ten-fold space of time.

The hasty exhalation, therefore, is not caused by the heat alone; neither does it seem to require any great surface. What else it is owing to, I commit for a while to the examination of the curious.

Orchard-Street, Portman-Square, Dec. 23, 1772.

B. Higgins.